DOCUMENT RESUME

ED 340 872 CE 059 978

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TITLE Writing Test Items.
PUB DATE 87
NOTE 23p.; Paper presented at the Northwest Conference on Competency-Based Vocational Education (Pasco, WA, October 26-28, 1987).
PUB TYPE Speeches/Conference Papers (150) -- Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Achievement Tests; Competency Based Education; *Guidelines; Performance Tests; Postsecondary Education; Secondary Education; Skill Development; *Task Analysis; *Teacher Made Tests; *Test Construction; Test Content; *Test Items; Vocational Education

ABSTRACT

This handbook provides guidelines for instructors to follow in developing test items for occupational task lists. It begins with directions for task analysis: identifying major performance steps of a task, identifying supporting knowledge for each performance step, identifying supporting performance skills for each performance step, identifying safety factors and employability skills, and identifying test item skills. Following the task analysis, directions for constructing cognitive and psychomotor test items are given. They include steps for writing knowledge test items, multiple-choice test items, and performance process test items, and creating a test item checklist for performance evaluation. Numerous examples are given of each type of test item. (KC)

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WRITING TEST ITEMS

Northwest Conference on CBVE
Pasco, Washington
1987

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FOREWORD

The purpose of this handbook is to provide guidelines for developing test items.

It is essential that instructors using the competency based method of instruction be able to accurately measure if a student has mastered the knowledge related to the performance of a task. To do this, the instructor must write valid and reliable test items. It is hoped that you will find the contents of this handbook useful in producing technically sound and highly relevant test items.

Credit is given to Martha Keeton, Curriculum Specialist, Office of Vocational Education in the writing and production of this handbook.

John Horton
Office of Vocational Education
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INTRODUCTION

A validated occupational task list lays the foundation for developing sound test items. All tasks which are used as sources for the development of test items must be performed on the job, have a definite beginning and ending, be observable or measurable, consist of two or more definite steps, and lead to a product, service, or decision.

A good test item is valid if it measures what it is designed to measure and nothing else. A good test item is reliable if it measures accurately and consistently and is designed so that the student has difficulty guessing the correct response. A good test item can be objectively scored and the examiner's opinion, bias, and individual judgement is eliminated.

A complete test is comprehensive when collectively assembled, the test items must liberally sample all phases of instructions within the program area. It is not necessary nor practical to test every point that is taught in a program; but a sufficient number of test items should be included to provide a valid measure of student competency in the completed program. A complete test can be readily administered and scored.

ANALYZING TASKS

A task analysis makes the writing of test items much easier and helps insure their validity. The analysis is a procedure for identifying what a student must know and do in order to perform the task. The analysis includes:

- Major performance steps of a task.
- Supporting knowledge(s) for each performance step.
- Supporting skills required for achieving each performance step.
- Safety factors and/or employability skills.
- Supplies, tools, and equipment required for performing a task.

NOTE: Up-to-date V-TECS catalogs are excellent sources for identifying the performance steps and the supplies, tools, and equipment required for performing a task.

IDENTIFYING MAJOR PERFORMANCE STEPS OF A TASK

What major activities must a student do to perform a task? Each task must be broken down into specific performance steps or procedures. For example:

- Task: Key from rough-draft copy.

  Performance Steps:
  1. Edit rough-draft copy.
  2. Key copy from rough draft.
  3. Proofread keyed copy.
  4. Correct errors.

- Task: Replace a defective switch.

  Performance Steps:
  1. Determine if the switch is defective.
  2. Install a new switch.
  3. Test the new switch for proper functioning.

IDENTIFYING SUPPORTING KNOWLEDGES FOR EACH PERFORMANCE STEP

What does the student have to know to accomplish each performance step? Knowledge cannot be observed, but must be

applied as a form of reasoning or recall. Below are examples which show how the task, performance steps, and what the student has to know are related:

- Task: Key from rough-draft copy.

Performance Step: 1. a. Edit rough-draft copy.

Know: 1. a. Proofreader's symbols.
b. English skills.

Performance Step: 2. Key copy from rough draft.

Know: 2. a. Machine manipulation.
b. Format rules.

- Task: Replace a defective switch.

Performance Step: 1. Determine if switch is defective.

Know: 1. a. Operation of the Ohmmeter.
b. Principles of a circuit.

Performance Step: 2. Install a new switch.

Know: 2. a. Tools and how to use them.
b. Wire color codes.

Sometimes a question arises as to which activities are knowledge related. The following list may be used as a means of identifying knowledges required to perform a task:

- Is knowledge of terminology required?
- Is knowledge of the location of components or integral parts required?
- Is knowledge of the operation of tools and equipment required?
- Is the interpretation of symbols or signals necessary?
- Do calculations have to be performed?
- Are the techniques of problem-solving, diagnosis, and trouble-shooting required?
- Is the anticipation of later conditions from observation of earlier conditions required?
- Is planning involved?

- Is the selection of strategies involved?
- Must the task be performed in accordance with briefing instructions?
- Is knowledge of the "why" of a procedure essential?

IDENTIFYING SUPPORTING PERFORMANCE SKILLS FOR EACH PERFORMANCE STEP

What does the student have to do to accomplish each performance step? A "do" skill is a manipulative action or a manual behavior that can be observed. Below are examples that show how the task, performance steps, and what the student has to do are related:

- Task: Key from rough-draft copy.

Performance Step: 1. Edit rough-draft copy.

Do: 1. a. Read through rough-draft copy.
b. Correct punctuation, spelling, and grammar errors.

Performance Step: 2. Key copy from rough draft.

Do: 2. Key copy in specified format.

- Task: Replace a defective switch.

Performance Step: 1. Determine if the switch is defective.

Do: 1. Check for continuity across terminals:
a. Calibrate ohmmeter.
b. Hook up leads.
c. Take a reading.

Performance Step: 2. Install new switch.

Do: 2.a. Remove defective switch.
(1) Disconnect wires.
(2) Disconnect fasteners.

b. Install new switch
(1) Fasten switch.
(2) Fasten wires.

The following list of questions may be used as a means for identifying the "Do" skills for performing a task:

- What are the students required to do with their hands?
- Do the students have to perform this activity at awkward angles or in unusual locations? (Is balance involved, such as climbing a ladder?)
- Does performance of this step involve unusually strenous activity? (Do the students have to lift or move weight?)
- Does performance of this activity require especially fine motor coordination? (Is critical welding involved? Are the students mixing potentially explosive chemicals?)
- Does performance require especially fine senses of touch (heat or cold), hearing (steam leaks), sight (oil leaks, distance), or smell (ammonia leaks)?

IDENTIFYING SAFETY FACTORS AND/OR EMPLOYABILITY SKILLS

What safety skills and employability skills does the student have to perform? A task may or may not include these skills, but adhering to safety rules is absolutely essential when performing potentially dangerous activties and must be included in the task analysis. Here is an example:

- Task: Replace a defective switch.

  Do: Check for continuity across terminals.

  Safety: Disconnect power.

Other steps often include employability skills which involve seeking, obtaining, keeping, and advancing in a job. An example of an employability skill is:

- Task: Receive telephone calls.

Employability skills: a. Answer promptly.
b. Speak courteously.

IDENTIFYING TEST ITEM SKILLS

Identifying the skills for which test items are to be developed, is a primary reason for producing a task analysis. To do this:

- Review the "KNOW" and "DO" skills.
- Identify those skills which are critical to performing the task.
- For each skill identified, determine how the student should be tested.

There are two types of test items to be considered: Cognitive (knowledge) test items and performance/product test items.

Cognitive Test Items. These test items are frequently referred to as test questions. They provide the student the opportunity to respond on paper. It is safe to assume that the "KNOW" skills can be adequately covered by cognitive test items; also, the student can demonstrate competence of a "DO" skill by responding to cognitive test items.

Performance/Product Test Items. There are certain tasks that require a student to go through the process in order to demonstrate competency. In other words, cognitive test items may not adequately test the student. When attempting to identify these skills a good question is: "Is it absolutely essential that students go through these procedures for performing this task, or can they demonstrate their competence by responding to relevant cognitive test items?" If it is decided that the student must perform, a performance test item can be developed.

SUMMARY

A task analysis will include:

- A breakdown of tasks into major performance steps.
- The support knowledges and subskills needed for each step.
- Safety and/or employability skills related to the task.
- Supplies, tools, and equipment needed to perform the task.
- Identification of skills for which test items will be written.

CONSTRUCTING TEST ITEMS

The objective of this section is to describe how to construct test items which relate to the "KNOW" and "DO" skills which are described in the task analysis. These test items must measure the student's knowledge of and/or the ability to safely perform specific occupational tasks.

The construction of two kinds of test items is addressed in this handbook.

Cognitive (Know) Test Items: Test items which are designed to measure students' knowledge of performing a specific task.

Psychomotor (Do) Test Items: Test items which are designed to measure students' ability (skill) to safely perform specific tasks.

Writing valid and technically accurate test items is not a difficult task when the follwoing criteria is followed.

Each test item should relate to a critical "KNOW" or "DO" skill in the task analysis.

The test item should measure the students' knowledge of or their ability to safely perform a specific task.

Test items should be technically accurate.

Test items should not be designed to measure "trivia."

A sufficient number of test items should be wirtten to adequately measure the students' knowledge of and their ability to perform the task.

Each test item should be constructed so that there is one, and only one, interpretation of the item.

CONSTRUCTING COGNITIVE (KNOWLEDGE) TEST ITEMS

Test items which measure the students' knowledge of performing specific occupational skills are referred to as cognitive (knowledge) test items. These items are designed to measure the students' ability to recall specific information that is related to performing a task.

These knowledge test items include the recall of

- Names and labels
- Facts
- Terminology
- Definitions
- Procedures and methods
- Stated rules

Test items in this first category are referred to as C-1 or Cognitive Level 1 items.

Test items that mesure the students' abilty to apply knowledge that is related to performing a specific task are also cognitive. These applications of knowledge test items include:

- Using formulas
- Interpreting charts, graphs and diagrams
- Classifying (objectives, concepts)
- Selecting appropriate rules to solve problems
- Applying rules to specific situations or conditions
- Solving "paper and pencil" problems; i.e., work problems, puzzles
- Solving "hands-on" problems (diagnosing, troubleshooting, debugging)
- Analyzing (comparing, contracting, distinguishing)
- Evaluating (judging, assessing)
- Synthesizing (designing, planning, organizing)

Test items in this second category are referred to as C-2 or Cognitive Level 2 Items.

C-1 Level Test Items. When the task analysis indicates that the students' recall of a critical cognitive (know) skill should be tested, a cognitive C-1 Level test item is constructed.

Below are examples of C-1 Level test items.

■ Task: Key from rough-draft copy.

Know Skill: Proofreading techniques

C-1 Level Test Item:

1. Proofread copy the first time:

   a. just before sending it in the mail.

   (*b.) While it is still in the machine or on the display screen.

   c. Immediately after it is removed from the machine or played back on the display station.

   d. When a co-worker is available to proofread along with you.

■ Task: Replace a defective switch.

Know Skill: Operation of Ohmmeter

C-1 Level Test Item:

The first step in using a Ohmmeter is to:

   a. Calibrate the meter.

   (b.) Select the scale.

   c. Connect the leads.

   d. Disconnect the leads.

C-2 Level Test Items. When the task analysis indicates that the students'ability to apply knowledge should be tested, a cognitive C-2 Level test item should be constructed.

The following are examples of C-2 Level test items:

*The circle represents the correct answer.

- Task: Key from rough-draft copy:

  Know Skill: Proofreader's symbols

  C-2 Level Test Item:

  1. ~~Keyed~~ copy that has been corrected in longhand is known as Rough Draft.

The sentence above has been edited. Which sentence below reflects the corrections indicated by the proofreader's symbols?

a. Keyed copy that has been corrected in long hand is known as rough draft.

b. Keyed copy that has been corrected in longhand is known as rough draft.

(c.) Copy that has been corrected in longhand is known as rough draft.

d. Copy that has been corrected in long hand is known as rough draft.

- Task: Replace a defective switch.

  Know Skill: Operation of Ohmmeter

  C-2 Level Test Item:

  1. To determine that there is continuity across terminals the Ohmmeter reading should be:

     a. Infinity

     b. 1000 Ohms

     c. 100 Ohms

     (d.) 0 Ohms

GUIDELINES FOR CONSTRUCTING MULTIPLE CHOICE TEST ITEMS

The following guidelines are helpful when constructing multiple choice test items:

- Present one and only one concept in the stem.
- Keep the stem positive unless an exception is to be emphasized. If an exception is emphasized, it should be underlined or capitalized.

- Select and include distractors which are grammatically consistent with the stem and with each other.
- Write test items which have one best answer.
- Avoid verbal association between the stem and the correct response.
- Include at least four distractors.
- Use plausible distractors.
- Position the distractors in a logical order; i.e.,

  --Numerical sequence

  --Alphabetical sequence
- Avoid length clues to the correct answer.
- Avoid using the options "all of the above" and "none of the above."
- Vary the position of the correct response by using a random location within the distractors.
- Avoid using a series of true-false statements as a multiple choice item.
- Include enough test items to adequately sample the skill.
- Construct test items that are independent of other test item answers.

Graphic Format. Some test items may use line drawings, pictures, or other presentations as a part of the stem or in the responses.

A graphic multiple-choice test item may be appropriate when it will present information better than words. For example:

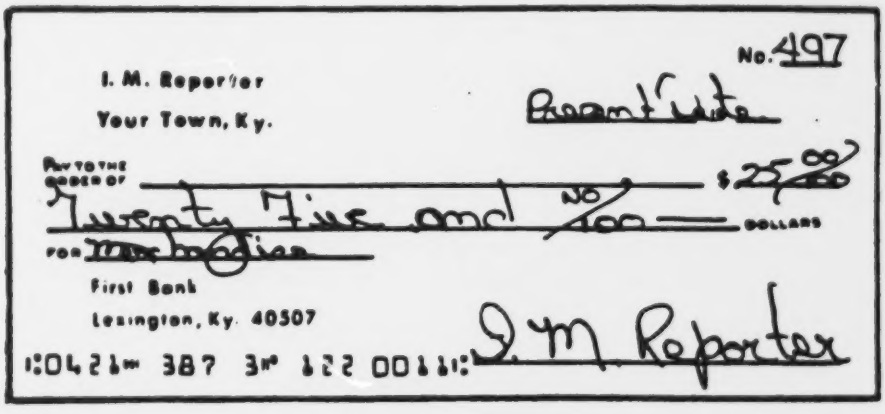
- The students' knowledge of specific parts of a product should be tested.
- The students' recall responses of tools, equipment, or materials needed for performing a task should be tested.
- The students' ability to select the correct tool for performing a specific task should be measured.
- The students' ability to identify the operation of tools and equipment, such as read meters.

- The students' ability to select correct operations in performing a task should be assessed.
- The students' ability to identify a step in an operation needs to be measured.
- The students' ability to recognize defective or damaged parts needs to be measured.
- The students' ability to recognize incorrect assembly of a specific part or assembly needs to be tested.
- The students' ability to identify the function of a part needs to be tested.

These are only a few of the reasons for constructing graphic test items. In summary, graphics can be used when "a picture is better than a thousand words."

Here is an example of a graphic test item.

1. The check shown below is presented by a customer to pay for purchased merchandise. Should the check be accepted by the salesclerk?



a. Yes, it is ok.

b. No, the signature is not proper.

c. No, the amounts do not match.

d. No, the payee is not filled in.

GUIDELINES FOR WRITING PSYCHOMOTOR (DO) TEST ITEMS

Performance items may be written for each psychomotor "Do" task that requires action. Performance items may be prepared that cover two or more tasks, an entire duty area, two or more duty areas, or an entire job title.

Performance/hands-on items should be written so that they can be evaluated in one of the following ways:

(1) Checklists.

(2) Rating Sheet.

(3) Other means that review the product (outcomes) or the process used to produce the project (outcomes).

Final Product Checklist. When a psychomotor task involves the evaluation of a product (not the process), a checklist may be developed. Here is an example of a final product checklist:

Task: Key from rough-draft copy.

Product Checklist:

The final keyed copy:	Yes	No
a. Is neat.	( )	( )
b. Includes the same information as contained in the rough draft	( )	( )
c. Reflects all corrections indicated . . .	( )	( )
d. Is free of spelling, punctuation, and grammatical errors	( )	( )

NOTE: The above items are taken from the standard of the performance objective.

For checklists designed to assess performance of a task that results in a tangible product, the following criteria is relevant:

- The checklist items are based on the way the product is supposed to look, oeprate, and be repaired on the job.
- The parts of the product are organized and described briefly and clearly.
- The checklist criteria are organized in a way that facilitates their assessment.
- Any two qualified raters using the checklist should be able to evaluate the same product in the same way or in nearly the same way.

Performance Checklist. Performance skills are measured by observing student performance and evaluating it with a checklist on the basis of stated criteria of acceptability. The format for psychomotor tasks would usually include a statement of the task or skill to be performed, and the criteria for evaluating the performance.

The test item also needs to include directions to the student; a list of equipment needed for the performance; and directions to the teacher/evaluator.

The checklist should specify whether all the criteria on the checklist are necessary for the student to pass the objective, or whether there are certain critical items on the checklist; if so, these should be identified.

You may follow these procedures when writing performance test items.

- Refer to the task analysis "DO" column and determine if a performance test item is needed to measure the students ability to perform the critical "DO" skill.
- Write a description of the skill that is to be performed.
- Write directions to students in language that will be understood by them.
- If a case situation is needed, write it.
- List the tools, materials, and equipment that will be needed to perform the test.
- Include all safety procedures and note special precautions.
- Write directions for the examiner. Include safety precautions.
- If time is a critical standard include the estimated time that should be allowed for performing the test item.
- Construct a performance checklist that can be used for evaluating the students' performance.

An example of a performance checklist follows:

PERFORMANCE/PROCESS TEST ITEM

The following is a performance test item: Instructions to the student and the examiner are included. This page precedes the actual checklist.

■ Task: Replace a Defective Switch.

Instructions to Examiner:

Indicate on the accompanying checklist whether or not each step was performed by the student.

Instructions to Student:

You will be given a circuit that has a defective switch and a new switch to install. Check the circuit and replace the defective switch.

Tools and Equipment:

Ohmmeter, flat head screw driver, open end wrench, new switch.

Estimated Time: Not applicable

*If student does not disconnect the power source this test should be stopped immediately.

TEST ITEM CHECKLIST FOR PERFORMANCE EVALUATION

When replacing the defective switch, the student:	Yes	No
a. Disconnected the power source. (This step must first be performed by the student. If it is not performed, the student must be told immediately to stop the test.)	( )	( )
b. Selected the correct Ohmmeter scale.	( )	( )
c. Calibrated the Ohmmeter.	( )	( )
d. Took a reading across the switch terminals with the Ohmmeter with switch in both the on and off position	( )	( )
e. Removed the fasteners holding the switch . .	( )	( )
f. Disconnected the wires	( )	( )
g. Fastened the wires to the new switch observing the color code	( )	( )
h. Replaced the fasteners that hold the switch	( )	( )
i. Reconnected the power to the circuit	( )	( )
j. Tested the switch by turning it on and off .	( )	( )

For tests designed to assess performance of a task that does not result in a tangible product, the following questions are relevant:

The checklist should include all safety procedures.

- The checklist standards should be based on the requirements of performing the task on the job.
- The checklist should include all important steps.
- The steps should be stated briefly and clearly.
- The steps should be sequenced in an acceptable order of performance.
- Any two qualified raters using the checklist should be able to evaluate the same performance in the same way or in nearly the same way.

Performance/Product Checklist. Some tasks require that both process and product be evaluated. This is particularly true when safety is involved. When both process and performance need to be measured, both a performance evaluation form and a product evaluation form should be completed.

Following is an example of performance and product test item.

Operating Gas Welding Equipment

Job 1: Oxyacetylene Welding, Butt Joint, Flat Position

Estimated Time: 15 minutes

Instructions to Student:

1. You will be given 2 pieces of 3" x 8" x 16-gauge mild steel. Make a butt joint with 1/16" root opening, flat position.
2. You will completely weld the joint on one side.
3. You will notify the examiner when you have finished so that your work may be inspected.

Instructions to examiner:

1. The maximum time for this test is four hours. In addition, each task has a time limit, from 10 to 70 minutes, printed at the top of the task.

2. If the student has not completed the task in the allotted time, the students should be told to clean up the testing area and return to the staging area for assignment to another task. Steps the student did not complete should be marked "NO" and a comment to that effect written.

3. Students completing the task in the allotted time should return the testing area to its pre-test condition and then return to the staging area for assignment to another task.

4. The examiner should make all ratings on individual student "Performance Evaluation Checksheets" as the work progresses. Rating information should not be be shared with the student. Upon completion of the task, each student's Guidesheets should be returned to the student's folder.

5. The examiner should complete a Product Evaluation form when the task is finished.

Instructions to Student:

1. You will be given 2 pieces of 3" x 8" x 16-gauge mild steel. Make a butt joint with 1/16" root opening, flat position.

2. You will completely weld the joint on one side.

3. You will notify the examiner when you have finished so that your work may be inspected.

Tools and Equipment: Oxyacetylene welding torch, hoses, gauges, two practice plates, welding rod

Estimated Time: 15 minutes

TEST ITEM CHECKLIST FOR PERFORMANCE EVALUATION

When operating gas welding equipment, the student:

		Yes	No
a.	Gas Welded Low and Medium Carbon Steels	( )	( )
b.	Selected proper tools and equipment	( )	( )
c.	Properly adjusted equipment	( )	( )
d.	Properly set-up metal	( )	( )
e.	Used proper techniques	( )	( )
f.	Practiced all safety requirements	( )	( )

TEST ITEM CHECKLIST FOR PRODUCT EVALUATION

The student's welded butt joint shows:

		Yes	No
a.	Butt Joint to Standards	( )	( )
b.	Proper width of bead	( )	( )
c.	No undercut	( )	( )
d.	Proper reinforcement	( )	( )
e.	Proper penetration	( )	( )
f.	Good ripple	( )	( )
g.	Uniformity	( )	( )

Tips for Writing Performance Test Items

- Examine the task analysis "DO" skills to determine what tasks would best be tested with performance test items.
- Determine if tools, materials, space and time restraints permit the performance test to be conducted.
- Prepare specific student directions for taking the performance test.
- Prepare directions for the examiner.
- Prepare a checklist for evaluting the students' performance. The checklist should be:

  --Free of subjective evaluation.

  --Designed to measure: (1) the students' ability to perform a process, (2) the quality of a produced product, (3) both the process and product.